

Key Factors in the Implementation of an Assessment Innovation: A Case Study

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The introduction of portfolios into the mathematics assessment programme of a New Zealand secondary school was closely monitored. The responses of teachers, students and parents are recounted in this paper. Inconsistencies in teachers' views and behaviour highlight the professionalism necessary for education reform.

It is difficult to successfully implement genuine reforms in education (Lieberman, 1998). The reform discourse can be stopped in its tracks by teacher unions, delayed, subverted, and even reversed (Broadfoot, 1998). Fullan (1993) relates three stories of failed implementation from the 1970s: open-plan schools, individualized instruction, and large-scale national curriculum efforts. Inevitably, the received curriculum differs from the official curriculum. The constraints of time, funding and talent conspire to produce mere approximations of the intended reform. Political interests, such as conservative schools keen to preserve traditional examinations, also blunt the impact of educational reform.

The portfolios innovation which was the subject of this study was initiated by a mathematics curriculum reform in New Zealand (Ministry of Education, 1992). The current curriculum requires that:

Assessment should, as far as possible, be integral to the normal teaching and learning programme. Continuing assessment as part of the teaching and learning programme increases the range and quality of assessment which can be carried out for good diagnosis, and avoids the artificial intrusion on learning and teaching time which is associated with separate assessment sessions. Assessment should involve multiple techniques including written, oral, and demonstration formats. Group and team activities should also be assessed. ...teachers should report what students have been working on, what they have achieved, and how well they have achieved it. A grade, level, or mark alone is insufficient (p. 15).

Faced with such curriculum requirements, teachers at the author's school were quick to support the introduction of portfolios as part of the mathematics assessment scheme. A portfolio was taken to be a collection of a student's work, often featuring problem-solving projects, selected by the student or prescribed by the teacher. Unanimity prevailed as the teachers could see little feasible alternative. And so the case study began, with a participant observer present for the first year and a mixture of quantitative and qualitative techniques to monitor developments.

Aims of the Study

The study sought to identify key factors facilitating change within the immediate school community. Teachers are central to educational reforms, but demands are also made on students and their parents. An attempt to gauge the response of each of these groups was made.

Methodology

A Mathematics Survey (Radalj, 1982) was employed to measure enjoyment of mathematics, perceived importance of mathematics, stress, and desire to improve mathematical skills. It was administered to all 500 students involved in the study at the very

beginning of the school year, and again near the end of the year once all the portfolio work had been completed. A standard instrument to measure classroom environment, "What is Happening In this Class?" (Fraser, Fisher & McRobbie, 1996), was administered during the year to the students and also their teachers. Three other questionnaires for teachers, administered at intervals over a two-year period, comprised of open-ended questions. A postal survey of parents was also conducted.

Taped interviews were conducted with small groups of students representing every participating class. The student interviews sought to validate information from the questionnaires and to provide a forum for unanticipated student ideas. Summaries of the results for their own classes and of the teacher surveys were distributed to the teachers. Taped interviews with the teachers were conducted at the end of the first year of the innovation.

Results

All four of the attitudinal variables quantified by the Mathematics Survey declined as interest in school waned throughout the year. A subsequent administration found that attitudinal variables largely recovered at the beginning of the following year. Individual students were tracked using anonymous self-generated code numbers on every questionnaire completed. This enabled links to be made between attitudinal variables and the classroom practices apparent from the What is Happening In this Class? survey.

High scores for the Investigation and the Task Orientation constructs were the best predictors of decline in the attitudinal variables. This is a surprising finding as the two constructs seem antithetical. Task Orientation consists of items such as "Class assignments are clear so I know what to do", whereas Investigation consists of items such as "I carry out investigations to answer questions coming from discussions". It may be that extreme approaches at either end of the constructivist classroom spectrum reduce the students' self-reported enthusiasm for mathematics. Alternatively, it was the practice within the mathematics department to allocate experienced staff to both high-ability and low-ability classes, and this may have introduced a bias in this 15 class sample. Skillful and enthusiastic teachers may initially induce high expectations about such things as enjoyment of mathematics, so measures of absolute decline may be inappropriate.

Interviews with students revealed that portfolios had little declared impact. The portfolio tasks called on investigation and presentation skills already honed in primary school and used in other subject areas. There was inconsistent treatment of the portfolios by the teachers in respect of the information given, class time devoted to doing the tasks, marking, and storage of the accumulating work. But the students were unperturbed by the innovation. Written tests were sometimes preferred because they take less time and are not subject to thoughtful revision, but sometimes reviled as "boring". New Zealand students equate assessment with tests (Fitzsimons, 1997), and are oblivious to the idea that portfolio work influences their real marks and ultimately their life chances.

The students were anxious about unfairness: that students with access to computers at home might get better marks for neatness; that uncooperative parents may not enable high-scoring interviews; and that rural students do not have access to the junk mail that was the subject of one task. Although 90% of students in the school remedial reading programme are boys, the students failed to mention that there would be one gender particularly handicapped by the literacy demands of portfolios.

The students voiced a very functional view of mathematics, and relegated analysis and synthesis tasks to other subject areas. The need to do mathematics was primarily seen in terms of getting a job, as illustrated by this exchange between two fourteen-year-old boys:

I just think there's not much point in doing algebra and that. ... The jobs you want to do don't need maths skills or anything. Like, algebra should actually be optional for kids that want to do it.

Yeah, if they've already made up the decision what sort of job they want to do they should go and do like that sort of maths. What's required for that job.

Students were not sure of the standards for a 'good' grade, and preferred the familiar percentage marks to any other system. Some had not been adequately briefed about the 20% contribution the portfolio mark made to their final mathematics grade. They liked to know what was coming up next, and used the advance warning to pick things up for their portfolios. They enjoyed working together on portfolio projects in class, whereas set homework was "boring" and often not attempted at home.

One teacher when asked about the unanticipated spinoffs from using portfolios replied "The enthusiasm that has taken students beyond my anticipated level of achievement". Another teacher acknowledged that portfolios had changed his teaching practice and was unruffled with what he perceived as the failure of one portfolio task with his class, adding "It may be that [in future] the suggestion which is made for the formal writing I don't take up and I want to take up one of my own...". This is more than recognition of the success or failure of the innovation, but a self-acknowledgement of the teacher's professional ability. Such self-assessment is a goal in the development of any capable teacher.

Portfolios were used as a vehicle to incorporate new experiences into the mathematics classroom programme. Some of this was overt, such as a mandatory computer programming task and a statistics assignment that had to be done on the computer, but much of it was by extension of the allowable responses of the students. Exhortation and a long lead time resulted in many students using a wordprocessor to complete projects at home. Other technologies used included the Internet, still photography, glue guns, and presentation folders. Many of the portfolios incorporated novice attempts at using display technologies such as scanning, clipart, Powerpoint, and colour printing. Some mathematics teachers conceded that portfolios had forced them to take classes to the school library to undertake research, to do role plays in class, to 'brainstorm' in class, and to teach formal writing skills. Some teachers encouraged student self-assessment. Collectively, this is an extensive list of brave new adventures by teachers and students, all of which is apparent to anyone who reads the portfolios produced. The latent effect of this is to encourage experimentation by both teachers and students in subsequent rounds.

It had long been the policy of the mathematics department to encourage all junior students to enter a poster or project in the annual regional school competition. The level of participation and of project quality varied greatly, and the classes of some teachers produced very little. With the introduction of portfolios as part of the assessment scheme, an entry for the annual competition became one of the tasks required of every student. In the first year of implementation the Head of Department used three classrooms to display the projects, and five hundred students toured the exhibition. This invasion of teaching spaces certainly drove home the point that every student and, more significantly, every teacher had to attempt the task.

It transpired from interviews with the students that one teacher had not distributed the portfolio tasks sheet to each student in the class. Although the interviews were not intended

as a monitoring exercise, student information-sharing produced a demand for equal treatment from the teachers. The problem was soon remedied.

During the second year of using portfolios, nine of the twelve teachers involved reported that the innovation prompted them to engage in focused discussion with colleagues. This took such forms as joint scrutiny of the work of students from two classes, brainstorming items for future use, planning programmes for weaker students, and sharing teaching strategies. Much of this was voluntary and not centrally organised.

Coordinators, designated Assistant Head of Department and paid a salary supplement of approximately 2%, were charged with drawing up the portfolio tasks, keeping everyone on track, and collating the portfolio marks for the students of one of the two year levels involved. The coordinators developed substantial teaching resources, for example a complete teaching programme for a week on spreadsheets. The coordinators noted inconsistent implementation and marking of portfolios and that some teachers felt 'pushed' into using portfolios, but they considered that the programme was worth continuing because it developed the students' pride in their work. They seem to have demonstrated the three components of Glatthorn's (1987) cooperative professional development: colleague consultation, coaching and reflection about practice.

Curiously, none of the other teachers acknowledged the help of the coordinators; their comments in interviews and questionnaires steadfastly focused on their own performance and that of their students. Kent (1985) found that "facilitators sometimes encountered jealousies of teachers who were not moving into new roles, because of the additional training and teamwork provided for these new roles" (as summarised by Nisbet, Dole and Warren, 1997, p.369). No such jealousies were volunteered in this study, perhaps because the author acted as a facilitator in the first year of the implementation, or perhaps because there was no training provided for the facilitators.

Holmes (1998, pp. 256-257) notes a trend in education "over the last twenty or so years" towards "denying the legitimacy of parents helping their children". Fink and Stoll (1998, pp. 299-300) discuss the community "contextual network" of schools and conclude that "innovations often fail because of the educators' inability or unwillingness to involve parents in meaningful ways in their development and implementation". The portfolios in this study sought to involve parents directly by such methods as mandating students to interview their parents about the mathematics parents actually use at work, and indirectly by providing shareware for home computer use and by requiring observations, such as sketching spider webs, to be recorded at home.

A postal survey of parents was conducted at the end of the first year of portfolios. On a score of 1 (Nothing) to 5 (Lots), the mean parent response to "How much involvement do you have with your son/daughter's mathematics homework?" was 2.19, with a modal score of 1. This was very close to a prediction survey conducted with the teachers. Comments by the parents included "maths homework doesn't seem to encourage parental involvement" and that parents "do not always understand the maths homework". The only parental contribution contemplated by four of the thirty parents who replied was hiring a private tutor for the student. However, some parents did report enjoying helping by being interviewed or assisting with mathematical research on the Internet. Parents appreciated knowing what was coming up in tests and projects.

Although many teachers reported no discussion with parents about portfolios, this was one teacher's experience:

With my kids the parent involvement was very strong. ... I took this [the portfolio task sheet] to parent interviews with me and ran through it with them and if they [the student] had done a piece of work I took it along and showed it to them and said 'this is what we're doing and have these things to do'. Some parents said to me 'Oh, yes, I've got this up on the fridge'."

Discussion

The portfolios innovation did not produce better marks for the participating students in the traditionally-styled final examination. The same examination paper was used for two years in a row with little discernable change in results for the portfolio cohort. But there was little interest by the teachers in this result. After all, the curriculum was being delivered, most of the students had generated impressive files of "personal best" completed work and, as was found in the Vermont study (Koretz et al., 1993), there had been a greater emphasis on problem-solving. Some of the teachers felt that formative assessment, as represented by portfolios, had led to less superficial learning, making mathematics "more real".

The decision to use portfolios became securely established by promotion of some teachers, exposure of the students to what would be expected of them in future years, and the irreversible commitment of publishing the assessment scheme to parents at the beginning of the year.

Many teachers have reservations about portfolios; for example, regarding them as unsuitable for low-ability students. Literacy problems and inability to undertake independent research rendered investigation-style tasks "useless" for such students. One teacher of a low-ability class said that:

For me, it [portfolios] was less to do with assessment and more to do with motivation, with actually handing in something that at the end of it the kids could look at the folder and say 'well, I actually achieved a few nice things throughout the year'.

Many different approaches were taken: ignoring or modifying the tasks; giving practice tasks first; strongly directing how to proceed in the investigation; and writing a different marking scheme more appropriate to the level of the class.

A number of the teachers taught the same class levels in other subjects such as Technical Drawing and Physical Education. This may have given them a better appreciation of the skills to expect of the students when it came to written prose, collating information from a variety of sources, and independent investigation. No formal comparison was made between written work in Mathematics portfolios and that in Social Studies or English.

Mathematics teachers are familiar with the expected results of an investigation. But they may have little on which to base their expectations of students' investigation and communication skills. At times this may result in confusion, with teachers impatient about the unexpected digressions of their students, and students who feel their creative work is undervalued. There was little evidence in the study that teachers scrutinised the written work their students produced in other subject areas.

Conclusions

The innovation in this case study is still in place. This implementation of portfolios in mathematics assessment allowed a great deal of scope for teachers to vary the programme. They could substitute the tasks, vary the marking schemes, collaborate with other

mathematics teachers, and call on the expertise and encouragement of nominated expert colleagues. In short, the teachers were empowered. This is unlike the state-wide implementation in Vermont (Koretz, Stecher, Klein, McCaffrey, & Diebert, 1993) which was closely moderated but which found better correlation between writing proficiency and the portfolio scores than between mathematical proficiency and the portfolio scores (p. 86).

Teachers did not only face a curriculum demand for changes in teaching practice, but they had to deal with year-level coordinators who required marks for the stipulated tasks to be entered into a computer in time to produce the student reports. The teachers were conscious of the research programme being undertaken and were also reminded of their responsibilities at frequent departmental meetings. Intrusion into classrooms reached a higher level, and there was more professional discussion focused on the students' learning. The immediacy of this monitoring was vital in overcoming resistance to change.

Those parents who took an interest found their involvement legitimated by appropriate tasks. Many found their non-mathematical expertise was called upon, for example, recalling the names of teachers who featured in the students' mathematical autobiographies. Parents appreciated publication of the assessment scheme and were pleased to see home computers put to good use.

The students were outwardly indifferent to portfolios in mathematics. Some threw their completed portfolios into the rubbish bin when they received them at the end of the year. Others had invested greater effort into their portfolio and saw it as an interesting artefact to preserve. Many enjoyed the opportunity to be creative and to employ novel means of presentation for their mathematical work. Some even pursued mathematical investigations far beyond the expectations of their teachers. Many escaped the need to make judgements about their own work, their teachers not insisting on a declared rationale and careful selection of portfolio items.

The streaming of mathematics classes by ability accounted for a considerable amount of the variation in the students' responses to portfolios. But the influence of the teachers was also significant, a conclusion which is supported by research over many years (Hall, George & Rutherford, 1979). Although required to implement the change, each teacher adapted the programme to the needs of their students. Between teachers, inconsistencies in implementation became so great that the Head of Department decided the portfolio marks had to be re-scaled to the same mean and standard deviation as the class examination marks. But this was not seen as the failure of the programme.

It is notable that many factors did not impact on the implementation of portfolios. There was no externally-sourced professional development for the teachers, the only resourcing being a more focused application of the usual management salary increments within the mathematics department. The school administration played little role in the implementation. The indifferent response of most students and many parents made no impression. Other departments within the school, including the remedial reading programme, were not consulted. Some mathematics staff became persuaded of the benefits of portfolios, while others retained serious reservations but worked to modify the programme to be useful for their students.

It is hard to know whether a "portfolio culture" (Duschl & Gitomer, 1991) flourished, however briefly, in some classrooms. This would require that the students truly understood why portfolios were used, and had internalised a self-critical approach to their own learning. The test of whether a portfolio culture existed is the test of all formative assessment: did the teachers and students change their teaching and learning activities as a result of the assessment

information they had obtained? (Black & Wiliam, 1998). In this study the teachers often spoke of changing their practice, but there was little evidence that the students undertook self-directed activity.

The factors which appear to have been most significant were the professionalism of the teachers and the openness with which the programme was managed. Implicit in many of the responses from the teachers involved was the idea that the teacher felt no compunction to deliver precisely the same programme as everyone else. The expertise of the teacher and the needs of the class were always factored into planned activities. Initiatives taken by teachers were shared formally and informally, and given a positive reception. Just as the portfolios were a celebration of the students' judgement and creativity, the implementation permitted the use of the same skills by the teachers.

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